

John A. Hipple (1911-1985): technology as knowledge

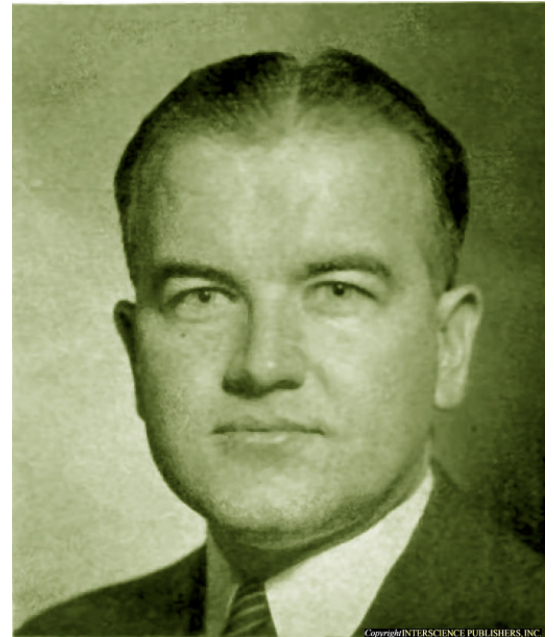
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Technology, referring to the knowledge of machines and the skills by which we use them, has helped human condition in many ways. J. A. Hipple has developed the relations between technology and science of ions to solve problems in physics discovering nuclear fission with the aid of mass spectroscopic research.

Keywords: history, mass spectrometry, mechanisms, instrumentation

Education: John Alfred Hipple Jr. was born in Lancaster, Pennsylvania in June 22, 1911 (son of John Alfred and Esther M. Brown) and was a student at Pen State College 1929-1932. He received the B.S. degree from Franklin and Marshall College in 1933.

The Princeton scientists of the laboratories of Physics and Chemistry having started grappling in 1930 with the most important problems of modern science heavy water [1], J.A. Hipple joined the Palmer Physical Laboratory. In 1935, he received an M.S. degree after having proved, with Pr. W.Bleakney, that the density change in heavy water should all be ascribed to deuterium isolated by electrolytic decomposition of ordinary water [2,3]. This was the subject of his Ph.D. degree in 1937 at Princeton where he explored the possibilities of the mass spectroscopy (MS)



developments. John A. Hipple was present at the Niels Bohr Institute conference in 1936 with Gregory Breit, Edward Uhler Condon, Henry Eyring, R. H. Fowler, and Hugh Stett Taylor, of Princeton University*.

History of MS had begun with Sir Joseph John Thomson with the discovery of the electron in 1897, awarded of 1906 Nobel Prize in Physics, and then MS increased fundamental aspects of matter and energy understanding. John A. Hipple went on to perform measurements at Princeton before constructing new mass spectrometers. He carried investigations in all directions and notably for a team composed of R. C. Herman, R. Hofstadter (Nobel prize in Physics 1961), J.M. Delfosse and Rene Puech [4]. MS for J.A. Hipple involved the practical skills of knowing and doing, characteristics of technology that expands knowledge through the investigations.

The heavy isotope of hydrogen (2H or D), discovered in late 1931, was an object of intense interest. Using emission spectroscopy, John A. Hipple detected the heavy isotope and analysed at the time “over one hundred samples from various sources, including meteorites, for possible oxygen isotopic variations.”[5].

Photography of R. Hofstadter, J.M. Delfosse and R. Puech at Princeton 1938 © B. Puech



Career. Mass spectrometry was rooted at Princeton in

the work of Edward U. Condon and Philip M. Morse who produced in 1929 the first English language book on quantum mechanics [6]. In spring 1937, Condon left Princeton to begin a new phase in his career – industry; Westinghouse wanted to strengthen work in atomic physics. Condon had the idea of having Westinghouse Research Fellowships to be patterned after the National Research Fellowships and John A. Hipple, who had him as a professor in Princeton, came for his first job as a fellow [7]. John Hipple was also a research engineer at Westinghouse (Pittsburgh) where he applied his science knowledge to the solution of technical problems with E. U. Condon, from May 1938 to 1940 [8]. The trochoidal mass spectrometer was originally described by Bleakney and Hipple (1938), it is sometimes called cycloidal mass spectrometers, although the path has loops. The J.A. Hipple device can sort out atoms of chemical substances by weight to aid science and industry. Determination of the accrued mass could provide information about the elemental composition. As the mass of compound of interest increased, so to did the need for greater resolving power; and the cyclotron has been used to determine resonance frequency of H^+ ions i.e., protons.

John Alfred Hipple, when not occupied with the requested analyses of outside samples has been building models for spectroscopy

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He married Eilen McIlroy in 1940 [9] when the fall of France occurred in the summer, and time of understanding atomic structure using mass spectrometry began to turn toward war work.

In war time, application of mass spectrometers as an analytical instrument of the hydrocarbon mixtures was crucial for the petroleum industries. Analysis of hydrocarbon molecules, connected to manufacturing processes, was to be investigated. One interest in compiling data, on occurrence of metastable transitions peaks in mass spectra, is that the transitions give some evidence as to the mechanism by which molecule ions dissociate. In charge of the task of creating a database of thermodynamic and thermophysical properties of selected Hydrocarbons; Stevenson and Hipple have found, in 1942, that in the butanes the transition $58^{+}-742^{++}16$ gives CH_4 and not $\text{CH}_3^{+} \text{H}$. This suggested that all metastable transitions involving loss of CH_4 imply a similar process. The affinity of the methyl radical for H removes an additional atom in the dissociation process; it was the first satisfactory direct determinations of the ionization potentials of free radicals.

Michael A. Grayson pointed in 2002 [10] that "Hipple was able to show that the diffuse peak patterns resulted from the decomposition of ions after they had left the ion source but before they entered the magnetic field of the mass analyser. On the basis of this observation he concluded that the diffuse peaks corresponded to unstable ions". In 1941, John Hipple had designed the first portable mass spectrometer which was marketed by Westinghouse Electric, so commercial mass spectrometers appeared and many researches were done on the mass analyser. An advance in ionization methods and mass analyzers was into focus and as greater experience was gained by Hipple, he improved the procedures.

When Condon became director of the National Bureau of Standards (NBS) in November 1945, Hipple had considerable opportunity to follow his ideas. The NBS became a laboratory making research on improving the measurement methods and John A. Hipple was chief of the Atomic Physics Section since the end of 1947 up to 1953. In 1949, John A. Hipple, Helmut Sommer, and Harold A. Thomas devised a method for determining the Faraday constant by purely physical means. At the time it helped Hipple to determine to high accuracy the gyromagnetic ratio of the proton by the high-field method established by an electromagnet. This quantity, p , is of how fast the axis of the proton's intrinsic rotational motion [11]. The Omegatron was developed by Sommer, Thomas and Hipple (1951). The positive ions move perpendicular to a magnetic field and are accelerated along helical paths of ever increasing radii (Archimedes spiral) by an adjustable radio-frequency electric field. This is somewhat similar to the cyclotron, where ions move in circular paths being accelerated with a sudden increase of radius twice per revolution, and it was called the "Omegatron" for the Greek letter used to denote angular frequency. [12-13]. FT-ICR (Fourier

transform ion cyclotron resonance) MS was described and evolved into one of the more powerful tools in mass spectrometry.

John A. Hipple, professor of Geophysics, course for Ph.D. "Potential Theory Applied to Earth Problems"; made a distinctive educational contribution as Director of the Mineral Industries Experiment Station, from 1954 to 1957 at the Pennsylvania State University [14]. There, he engaged a large research program, with the support of the Atomic Energy Commission, to provide fundamental information on the nature, occurrence and origin of uranium. Procedures for laboratory testing have been developed for evaluation of characteristics of minerals and a wide range of fundamental investigations relating to materials has been undertaken to provide a way for students to integrate science learning [15].

Elected at the New York Academy of Sciences June 20, 1957 [16], he started a new industry experience at North American Philips Co., Inc., 100 E. 42d St., New York 17, N. Y. , as vice President and Director of Research on semiconductors and solid state physics, microwaves, X-rays, crystallography, magnetic, thermionics, cryogenics, radiation detection, chemistry; employing one hundred persons [17].

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